In the Claims:

1. (Original) A reflectometer apparatus, comprising:

a light source that is utilized to create a sample channel light path;

at least one reference channel light path, the reference channel light path configured to not encounter a sample;

at least one optical element selectively enabling or disabling at least one of the reference channel light path or the sample channel light path; and

a plurality of reflectometer system elements that are shared by both the sample channel light path and the reference channel light path,

wherein the reference channel light path is configured to collect data that may be utilized to account for system or environmental changes to adjust reflectance data obtained through the use of the reflectometer.

2. (Original) The apparatus of claim 1, wherein sample channel light path and the reference channel light path are established using one or more beam splitter devices to divide a source beam from the light source and to subsequently recombine said divided portions such that they are directed to a common diffraction element and a common detector.

3. (Original) The apparatus of claim 2, wherein selection of individual channels is accomplished through use of controllable apertures.

4. (Original) The apparatus of claim 3, wherein the controllable aperatures are optical shutters.

5. (Original) The apparatus of claim 2, wherein one or more of the beam splitter devices are comprised of a partially transmissive beam splitter obscuring the entire beam diameter or a fully reflecting mirror obscuring some portion of the entire beam diameter.

6. (Original) The apparatus of claim 1, wherein the reference channel light path and the sample channel light path comprise balanced arms of an interferometer.

7. (Original) The apparatus of claim 6, wherein the interferometer is a Mach-Zehnder interferometer or a Michelson interferometer.

8. (Original) The apparatus of claim 1, wherein the sample channel light path and the reference channel light path are established using two or more controllable apertures in the form of motorized fully reflecting mirrors to direct the entirety of a source beam from the light source through either the sample channel light path or the reference channel light path and to direct the sample channel light path and the reference channel light path to a common diffraction element and a common detector.

9. (Original) The apparatus of claim 1, wherein the reference channel light path and the sample channel light path are of near-equal optical path lengths in order to minimize environmental effects resulting from absorbing species in below deep ultra-violet (DUV) wavelengths.

10. (Original) The apparatus of claim 1, wherein the apparatus is sufficiently compact so as to facilitate integration into process tools so that in in-line measuring, monitoring and control may be advantageously obtained.

11. (Original) A reflectometer, comprising:

a light source that is utilized to create a sample channel light path, the sample channel light path configured to encounter a sample having at least one unknown property; and

means for referencing the reflectometer to enable an adjustment of reflectance data obtained from the sample to account for reflectometer or environmental changes between a reflectometer calibration time and the time the sample reflectance data is obtained,

wherein the means for referencing includes a reference channel light path.

12. (Original) The reflectometer of claim 11, wherein the sample channel light path and the means for referencing form the balanced arms of an interferometer.

13. (Original) The reflectometer of claim 12, wherein the interferometer is a Mach-Zehnder interferometer or a Michelson interferometer.

14. (Original) The reflectometer of claim 11, wherein sample channel light path and the reference channel light path are established using one or more beam splitter devices to divide a source beam from the light source and to subsequently recombine said divided portions such that they are directed to common portions of a diffraction element and a detector.

15. (Original) The reflectometer of claim 14, wherein selection of individual channels is accomplished through use of controllable apertures.

16. (Original) The reflectometer of claim 15, wherein the controllable apertures are optical shutters.

17. (Original) The reflectometer of claim 11, wherein the sample channel light path and the reference channel light path are established using two or more controllable apertures in the form of motorized fully reflecting mirrors to direct the entirety of a source beam from the light source through either the sample channel light path or the reference channel light path and to direct the sample channel light path and the reference channel light path to a common diffraction element and a common detector.

18. (Original) The reflectometer of claim 11, wherein the reference channel light path and the sample channel light path are of near-equal optical path lengths in order to minimize environmental effects resulting from absorbing species in below deep ultra-violet (DUV) wavelengths.

19. (Original) The reflectometer of claim 18, further comprising at least one environmentally controlled chamber, the sample channel light path and the reference channel light path formed at least in part in the one environmentally controlled chamber.

20. (Original) The reflectometer of claim 11, wherein the reference channel light path does not encounter an unknown sample or a calibration sample.

21. (Original) The reflectometer of claim 11, wherein the reference channel light path and the sample channel light path share a common source, diffraction grating and detector.

22. (Currently Amended) A method of obtaining reflectance data from a first sample, comprising:

providing a sample optical channel;

providing a reference optical channel, the sample optical channel and the reference optical channel sharing at least some common optical elements including common portions of at least [a diffraction grating and] a detector <u>and a spatially separating optical element that spatially separates wavelengths;</u>

utilizing the reference optical channel to obtain referencing data with the detector, the reference data indicative of system or environmental parameters independent of the use of any sample in the sample optical channel path; and

referencing the reflectance data obtained from the sample optical path by utilizing the referencing data associated with the collection of sample reflectance data from the first sample.

23. (Original) The method of claim 22, wherein the first sample is an unknown sample.

24. (Original) The method of claim 22, wherein the first sample is a calibration sample.

25. (Original) The method of claim 22, wherein the referencing data is collected proximate in time with the collection of the first sample reflectance data.

26. (Original) The method of claim 22, wherein the first sample is an unknown sample and wherein the referencing of the reflectance data accounts for system or environmental changes between a calibration time and the time the first sample reflectance data is obtained.

27. (Original) The method of claim 22, wherein the first sample is a calibration sample, the method further comprising performing a reflectance measurement for an unknown sample.

28. (Original) The method of claim 27, wherein the referencing data associated with the reflectance measurement of the calibration sample is detected proximate in time to obtaining reflectance data from the calibration sample.

29. (Original) The method of claim 28, further comprising obtaining referencing data associated with the unknown sample.

30. (Original) The method of claim 22, wherein the first sample is an unknown sample, the method further comprising performing a reflectance measurement for a calibration sample.

31. (Original) The method 30, wherein the referencing data associated with the reflectance measurement of the unknown sample is detected proximate in time to obtaining reflectance data from the sample.

32. (Original) The method of claim 31, further comprising obtaining referencing data associated with the calibration sample.

33. (Currently Amended) A method of obtaining reflectance data from an unknown sample, comprising:

providing a sample optical channel;

providing a reference optical channel, the sample optical channel and the reference optical channel sharing at least some common optical elements including common portions of at least [a diffraction grating and] a detector and a spatially separating optical element that spatially separates wavelengths;

utilizing the detector to detect reflectance data from a calibration sample;

utilizing the reference optical channel to obtain first referencing data with the detector proximate in time to the calibration, the first reference data indicative of system or environmental parameters independent of the use of any sample in the sample optical channel path;

utilizing the detector to detect reflectance data from an unknown sample;

utilizing the reference optical channel to obtain second referencing data with the detector proximate in time to the detecting of the unknown sample reflectance data, the second reference data indicative of system or environmental parameters independent of the use of any sample in the sample optical channel path; and

referencing the reflectance data obtained from the unknown sample by utilizing the first referencing data and the second referencing data.

34. (Original) The method of claim 33, wherein the sample optical channel and the reference optical channel form the balanced arms of an interferometer.

35. (Original) The reflectometer of claim 34, wherein the interferometer is a Mach-Zehnder interferometer or a Michelson interferometer.

36. (Original) The reflectometer of claim 33, wherein sample channel optical channel and the reference optical channel are established using one or more beam splitter devices to divide a source beam from the light source and to subsequently recombine said divided portions such that they are directed to common portions of the diffraction grating and the detector.

37. (Original) A reflection measurement apparatus which operates below deep ultra-violet (DUV) wavelengths, the apparatus comprising:

a light source, the light source providing a source beam including wavelengths at or below DUV wavelengths;

a sample channel light path;

a reference channel light path;

a spectrometer that receives light from the sample channel light path after the light has been reflected from a sample; and

a detector that receives wavelengths of light at or below DUV wavelengths transmitted from an output of the spectrometer,

wherein the reference channel light path is utilized for referencing the reflectometer so that at least some reflectometer system characteristics may be obtained proximate in time to obtaining reflectivity data from the sample.

38. (Original) The apparatus of claim 37, the referencing enabling an adjustment of reflectance data obtained from the sample to account for apparatus or environmental changes between an apparatus calibration time and the time the sample reflectance data is obtained.

39. (Original) The apparatus of claim 37, further comprising at least one environmentally controlled chamber in which the sample channel light path and the reference channel light path are contained at least in part.

40. (Original) The apparatus of claim 37, wherein the sample channel light path is configured to encounter the sample and the reference channel light path is configured so that it does not encounter the sample, and wherein the sample channel light path and the reference channel light path can be selected through manipulation of one or more controllable apertures.

41. (Original) The apparatus of claim 40, the sample channel light path and the reference channel light path sharing common portions of a diffraction grating and a detector.

42. (Original) The apparatus of claim 37 wherein sample channel light path and the reference channel light path are established using one or more beam splitter devices to divide the

source beam and to subsequently recombine said divided portions such that they are directed to common diffraction elements and detectors.

43. (Original) The apparatus of claim 42 wherein the selection of sample channel light path or the reference channel light path is accomplished through use of controllable apertures in the form of optical shutters.

44. (Original) The apparatus of claim 42 wherein one or more of the beam splitter devices are partially transmissive beam splitters obscuring the entire beam diameter or fully reflecting mirrors obscuring some portion of the entire beam diameter.

45. (Original) The apparatus of claim 37, wherein the sample channel light path and the reference channel light path are established using two or more controllable apertures in the form of motorized fully reflecting mirrors to direct the entirety of the source beam through either the sample channel light or the reference channel light path and to direct the reference channel light path and the sample channel light path to a common diffraction element and a common detector.

46. (Original) The apparatus of claim 37, wherein the reference channel light path and the sample channel light path are of near-equal optical path lengths in order to minimize environmental effects resulting from absorbing species that absorb wavelengths of below DUV.

47. (Original) The apparatus of claim 46 wherein reference and sample channels comprise balanced arms of an interferometer.

48. (Original) The apparatus of claim 47 wherein the interferometer is a Mach-Zehnder or Michelson interferometer.

49. (Original) The apparatus of claim 37, the apparatus further comprising at least two environmentally controlled chambers connected via at least one coupling mechanism.

50. (Original) The apparatus of claim 49, wherein sample channel light path and the reference channel light path are established using one or more beam splitter devices to divide the source beam and to subsequently recombine said divided portions such that they are directed to a common diffraction element and a common detectors

51. (Original) The apparatus of claim 50, wherein selection of one of the sample channel light path or the reference channel light path is accomplished through use of controllable apertures.

52. (Original) The apparatus of claim 50, wherein one or more of the beam splitter devices are partially transmissive beam splitters obscuring the entire beam diameter or fully reflecting mirrors obscuring some portion of the entire beam diameter.

53. (Original) The apparatus of claim 49, wherein the sample channel light path and the reference channel light path are established using two or more controllable apertures in the form of motorized fully reflecting mirrors to direct the entirety of the source beam through either the sample channel light path or the reference channel light path to recombine the reference channel light path and the sample channel light path so that both paths have a common diffraction element and a common detector.

54. (Original) The apparatus of claim 49, wherein reference channel light path and the sample channel light path are of near-equal optical path length in order to minimize environmental effects resulting from species that absorb wavelengths below DUV wavelengths.

55. (Original) The apparatus of claim 54, wherein the reference channel light path and the sample channel light path comprise balanced arms of an interferometer.

56. (Original) The apparatus of claim 55, wherein the interferometer is a Mach-Zehnder or Michelson interferometer.

57. (Original) The apparatus of claim 37, wherein the detector is an array detector that receives the multiple spatially separated wavelengths of light to enable reflectance data to be simultaneously obtained for multiple sites within a two-dimensional area of the sample.

58. (Original) The apparatus of claim 57, wherein the wherein the sample channel light path is configured to encounter the sample and the reference channel light path is configured so that it does not encounter the sample, and wherein the sample channel light path and the reference channel light path can be selected through manipulation of one or more controllable apertures.

59. (Original) The apparatus of claim 58, wherein the sample channel light path and the reference channel light path share a common diffraction element and and a common detector.

60. (Original) The apparatus of claim 58, wherein the sample channel light path and the reference channel light path are established using one or more beam splitter devices to divide the source beam and to subsequently recombine said divided portions such that they are directed to a common diffraction element and a common detector.

61. (Original) The apparatus of claim 58, wherein reference channel light path and the sample channel light path are of near-equal optical path length in order to minimize environmental effects resulting from species that absorb wavelengths of less than DUV wavelengths.

62. (Original) The apparatus of claim 61, wherein reference channel light path and the sample channel light path comprise balanced arms of an interferometer.

63. (Original) The apparatus of claim 62, wherein the interferometer is a Mach-Zehnder or Michelson interferometer.

64. (Original) The apparatus of claim 57, further comprising at least one optical element that is a reflective optic.

65. (Original) The apparatus of claim 64, wherein the at least one optical element is an off-axis parabolic mirror.

66. (Original) The apparatus of claim 65, wherein the off-axis parabolic mirror has undergone conventional polishing to remove diamond turning artifacts introduced during its manufacture in order to improve imaging performance.

67. (Original) The apparatus of claim 65, wherein the off-axis parabolic mirror is designed to operate 90° off central ray axis of mirror.

68. (Original) The apparatus of claim 64, wherein the reflective optics are coated with broad-band reflective coating to enhance reflectivity of below DUV wavelengths.

69. (Original) The apparatus of claim 68, wherein the broad-band VUV-UV reflective coating comprises aluminum and MgF_2.

70. (Original) The apparatus of claim 57, wherein the array detector is a charge coupled device (CCD).

71. (Original) The apparatus of claim 70, wherein the CCD is of the back-thinned, back-illuminated design.

72. (Original) The apparatus of claim 57, wherein the spectrometer is an imaging spectrograph designed in such a manner as to provide stigmatic imaging in a large area flat field through incorporation of corrective optics.

73. (Original) The apparatus of claim 57, wherein a beam conditioning module is introduced between the source and the spectrometer for the purposes of modifying the spatial or temporal coherence of the of the source beam or for modifying the spectral properties of the source beam.

74. (Original) The apparatus of claim 57, the apparatus being sufficiently compact so as to facilitate integration into process tools so that in in-line measuring, monitoring and control may be advantageously obtained.

75. (Original) An optical reflectometer for obtaining reflectance data from a two-dimensional sample area, the reflectometer comprising:

a light source providing a light beam;

a plurality of optical elements configured to utilize a sample channel beam path to direct the light beam to and from a two-dimensional sample area;

at least one reference channel beam path, the reference channel beam path configured to not encounter a sample;

at least one optical element selectively enabling or disabling at least one of the reference channel beam path or the sample channel beam path;

a spectrometer that is in both the reference channel beam path and the sample channel beam, the spectrometer providing multiple spatially separated wavelengths of light at an exit of the spectrometer; and

an array detector that that is in both the reference channel beam path and the sample channel beam, the array detector receiving the multiple spatially separated wavelengths of light to enable reflectance data to be simultaneously obtained for multiple sites within the two-dimensional sample area,

wherein the reference channel beam path is configured to collect data that may be utilized to account for system or environmental changes to adjust reflectance data obtained through the use of the reflectometer.

76. (Original) The reflectometer of claim 75 wherein the light source provides wavelengths below DUV wavelengths.

77. (Original) The reflectometer of claim 76, wherein the reference channel beam path and the sample channel beam path are of near-equal optical path lengths in order to minimize

environmental effects resulting from absorbing species in below deep ultra-violet (DUV) wavelengths.

78. (Original) The reflectometer of claim 77, further comprising at least one environmentally controlled chamber in which the sample beam path and reference beam path are formed.

79. (Original) The reflectometer of claim 78, further comprising a plurality of environmentally controlled chambers, at least one chamber being a sample chamber.

80. (Original) The reflectometer of claim 75, the referencing channel beam path enabling an adjustment of reflectance data obtained from the sample to account for reflectometer or environmental changes between an reflectometer calibration time and the time the sample reflectance data is obtained.

81. (Original) A method of analyzing the reflectance characteristics of a sample utilizing a reflectometer, the method comprising:

providing at least one light beam;

directing the light beam on a two-dimensional area of a sample by utilizing a sample optical channel;

receiving at least a portion of the light beam within an imaging spectrometer after the light beam has been reflected from the sample;

providing multiple spatially separated wavelengths of light at an exit plane of the spectrometer;

receiving the multiple spatially separated wavelengths of light with a two-dimensional array detector in order to allow reflectance data to be simultaneously obtained for multiple sites within the two-dimensional area of the sample;

providing a reference optical channel, the sample optical channel and the reference optical channel sharing at least some common optical elements;

utilizing the reference optical channel to obtain referencing data with the detector, the reference data indicative of system or environmental parameters independent of the use of any sample in the sample optical channel path; and

referencing the reflectance data obtained from the sample optical path by utilizing the referencing data associated with the collection of sample reflectance data from the sample.

82. (Original) The method of claim 81, wherein the referencing channel beam path enables an adjustment of sample reflectance data to account for reflectometer or environmental changes between an reflectometer calibration time and the time the sample reflectance data is obtained.

83. (Original) The method of claim 82, further comprising performing pattern recognition with a camera so that the reflectance data is obtained from a desired two-dimensional area of the sample.

84. (Original) The method of claim 81, wherein the reflectance data resolved by the array detector includes data for wavelengths below DUV.

85. (Original) The method of clam 84, wherein the reflectance data resolved by the array detector includes data for wavelengths less than about 140 nm.

86. (Original) The method of claim 81, further comprising:

transmitting the light beam in at least one environmentally controlled chamber; and

controlling the environment within the at least one environmentally controlled chamber to allow transmission of wavelengths below DUV light.

87. (Original) The method of claim 86, wherein the at least one environmentally controlled chamber is a sample chamber.

88. (Original) The method of claim 87, wherein the light beam is transmitted through a plurality of the environmentally controlled chambers.

89. (New) The method of claim 22, wherein the first spatially separating optical element is a diffraction grating.

90. (New) The method of claim 33, wherein the first spatially separating optical element is a diffraction grating.